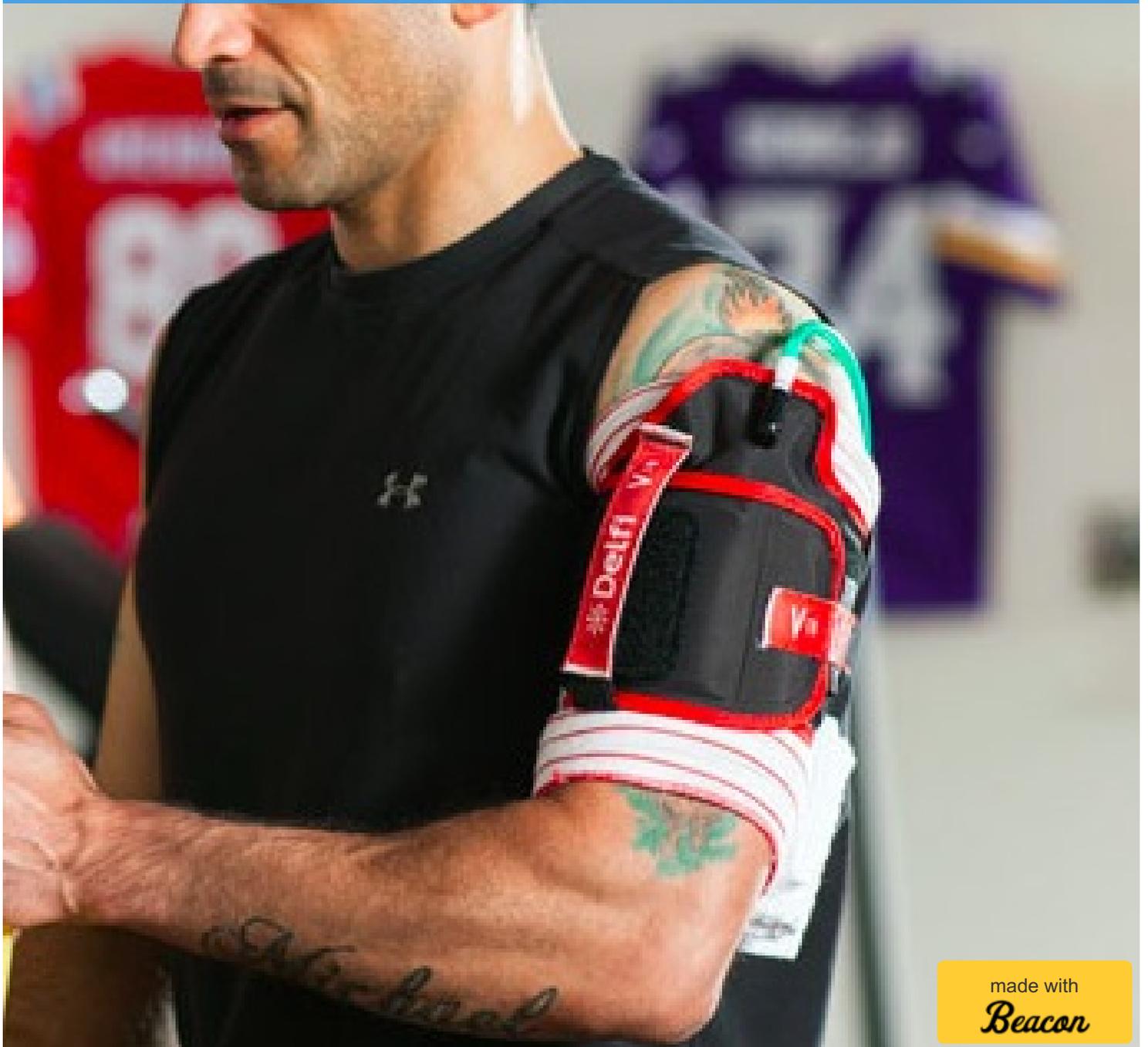


Blood Flow Restriction Training

A guide to implementation of BFR training.



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Table of Contents

1. About The Author

2. The Science of Blood Flow Restriction Training

3. The Application of Blood Flow Restriction for Performance Gains

4. The Best Blood Flow Restriction Bands and Devices

About The Author

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Zach Long is a board certified specialist in sports physical therapy and Strength & Conditioning coach.

He attended the University of North Carolina at Chapel Hill, where he majored in exercise and sport science, and East Carolina University, where he earned his doctorate in physical therapy.

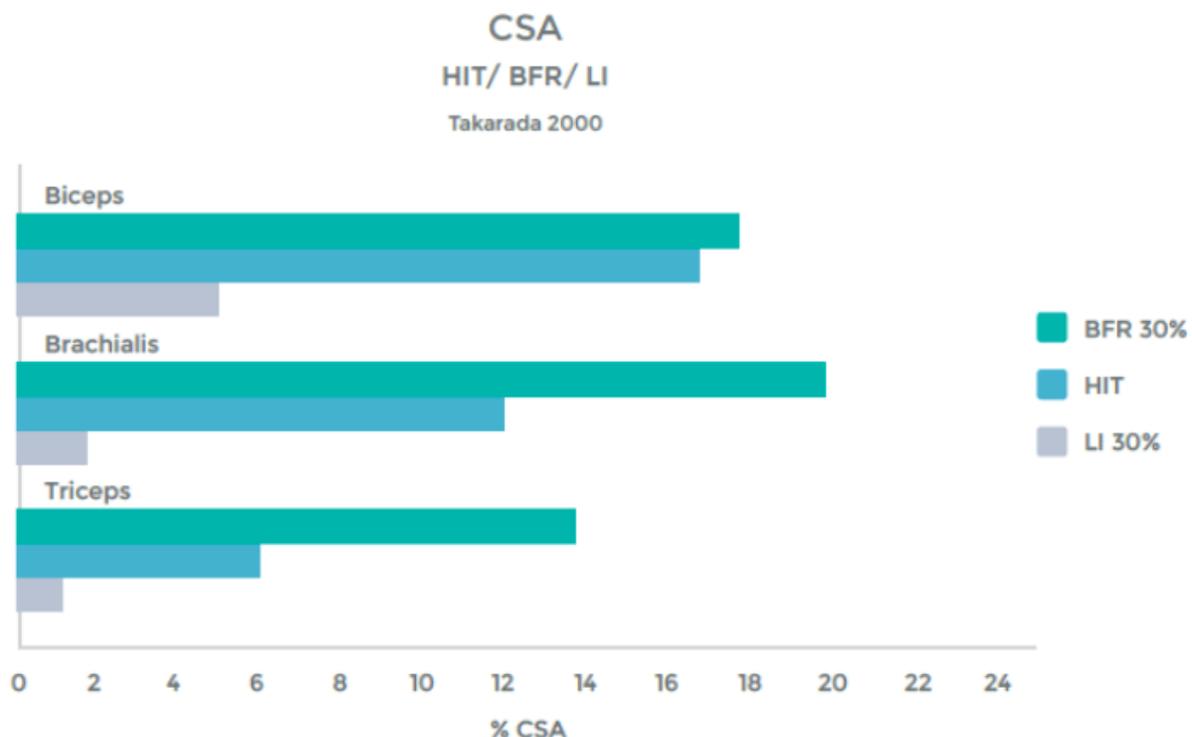
Long's work focuses on rehab and performance of athletes of all skill levels. He currently teaches BFR rehab as part of the clinical education team at OwensRecoveryScience.com.

The Science of Blood Flow Restriction Training

[Blood flow restriction training](#) is one of the newest training tools to hit both the rehab and performance worlds and with good reason, there is a lot of research coming out supporting the use of this modality for strength and hypertrophy gains.

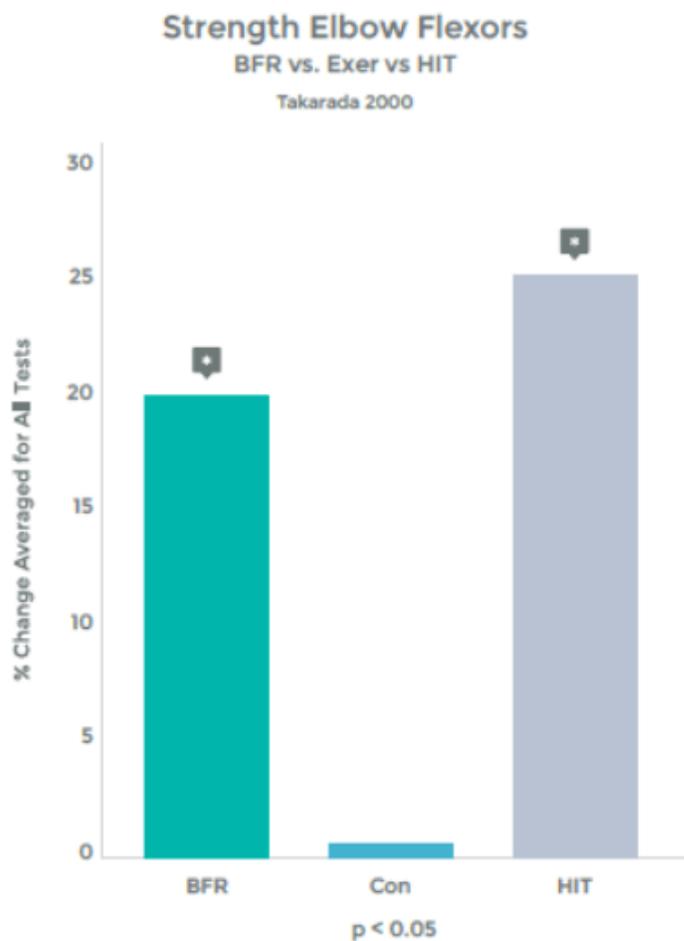
The majority of research focuses on looking at strength and hypertrophy gains during [BFR training](#). Research on traditional loading requirements for hypertrophy during weightlifting suggests loads as heavier than 65% of an individual's one rep max (1rm) must be used to create hypertrophy gains. So a 200lb bench presser must bench at loads greater than 130lbs to create a hypertrophy response.

Research on blood flow restriction training shows that loads as low as 20-30% of 1rm can create the same hypertrophy stimulus!



Comparison of traditional high intensity resistance exercise (HIT) to BFR training and low intensity training (LI)

Other research looking at strength gains has show **significant increases in strength during BFR training**. Compared to typical high intensity training, these strength gains are less, but can still have significant impact on an athlete's return from injury or their sports performance.



Comparison of traditional high intensity resistance exercise (HIT) to BFR training and low intensity training (LI)

So how does BFR create this hypertrophy and strength stimulus? Let's first look at a simplified formula for muscle growth:

Amount of Muscle Growth =

Muscle Protein Synthesis – Muscle Protein Breakdown

Simply put if you add more protein to your muscles than you

breakdown, you will build muscle. If you breakdown more than you synthesis, you lose muscle.

MUSCLE PROTEIN BREAKDOWN

In traditional resistance exercise, loading the muscle stretches the sarcomeres leading to cytoskeletal matrix damage. An inflammatory cascade follows to build muscle (there is currently multiple theories on this out there but I'm not going into any details).

During BFR, measures of muscle damage such as creatine kinase, lipid peroxides, torque output of muscles, and delayed onset muscle soreness (DOMS) are minimally elevated. Meaning in our muscle growth formula, **we don't have muscle protein breakdown!**

MUSCLE PROTEIN SYNTHESIS

During blood flow restriction training, limited oxygen to the muscle means that the slow-twitch, Type I muscle fibers aren't very active as they require oxygen as fuel. Instead, the bigger, faster Type II muscle fibers are recruited. To recruit Type II muscle fibers during traditional resistance exercises we usually need to perform exercises at very high intensity. But the oxygen limitations flip that upside down!

Why does that matter? Lactate acid is very important to growth hormone release. In fact, **growth hormone secretion levels are 170% higher after BFR than traditional resistance exercises!**

Now contrary to popular belief, growth hormone is not involved in protein synthesis or muscle hypertrophy. Instead, it serves a protective role for tendons and muscle collagen structures as it increases collagen synthesis. This has important rehab from injury implications as well as making BFR a great tool for recovery in athletes.

When it comes to the genes and hormones directly related to muscle hypertrophy, BFR has been shown to have significant positive benefits on IGF-1, MTORC1, and myostatin.

Meaning that blood flow restriction training creates a large increase in muscle protein synthesis.

Back to our muscle growth formula....

A large increase in protein synthesis with little muscle damage means we are putting the body in a very good place for building muscle!

As a great case example, elite Olympic weightlifter Jared Fleming tore his ACL at the world championships and did his rehab with me utilizing blood flow restriction training. While lots of research suggests that 65% of patients demonstrate >20% quad weakness compared to contralateral 1 years after ACL reconstruction (Sachs 1989), Jared's surgical leg was 1 inch larger than his healthy leg three months after surgery!

<https://www.instagram.com/p/BDEIsIxBE20/?taken-by=thebarbellphysio>

Here is a quick overview of all of the above:

	High intensity (HIT)	(BFR) +low intensity	Low intensity
Training range	65 – 90% %1 RM	20 – 35% 1 RM	20 – 35% 1 RM
Muscle Damage (Creatine Kinase)	Present	Not significant	Not significant
Lactate production (mmol)	Similar	Similar	Not present
Neuromuscular (Type II recruitment)	Type II activation near maximal effort	Type II activation at sub max effort	No additional recruitment
Growth Hormone	100 fold increase	1.7 X greater than HIT	No change from baseline
IGF-1	Increase	Significant Increase	No change from baseline
MTOR1C	Increase	Significant Increase	No change from baseline
<u>Mvostatin</u>	Down regulation	Down regulation	No change from baseline
Time to adaptation	12 weeks	2 weeks	

Blood Flow Restriction from LiftersClinic.com

For clinicians wanting to know more about blood flow restriction training, check out courses offered at [OwensRecoveryScience.com](https://www.owensrecovery.com).

The Application of Blood Flow Restriction for Performance Gains

Blood flow restriction training has emerged as a game changing rehab and performance tools. While traditional resistance exercise strength & hypertrophy must be done with heavy loads, blood flow restriction is the opposite. With blood flow restriction strength and hypertrophy gains have been shown in research at loads as low as 20% of an individual's one rep maximum.

[For a quick recap of the research](#), blood flow restriction training doesn't break down the muscle like traditional resistance exercise because the loads are so light. Instead, BFR creates huge amounts of protein synthesis due to the hormonal responses the body has to BFR training.

While the majority of research has focused on rehab implications of blood flow restriction training, there are also lots of potential performance enhancement results for athletes wanting to perform at their best. blood flow restriction strength

Cuff Placement

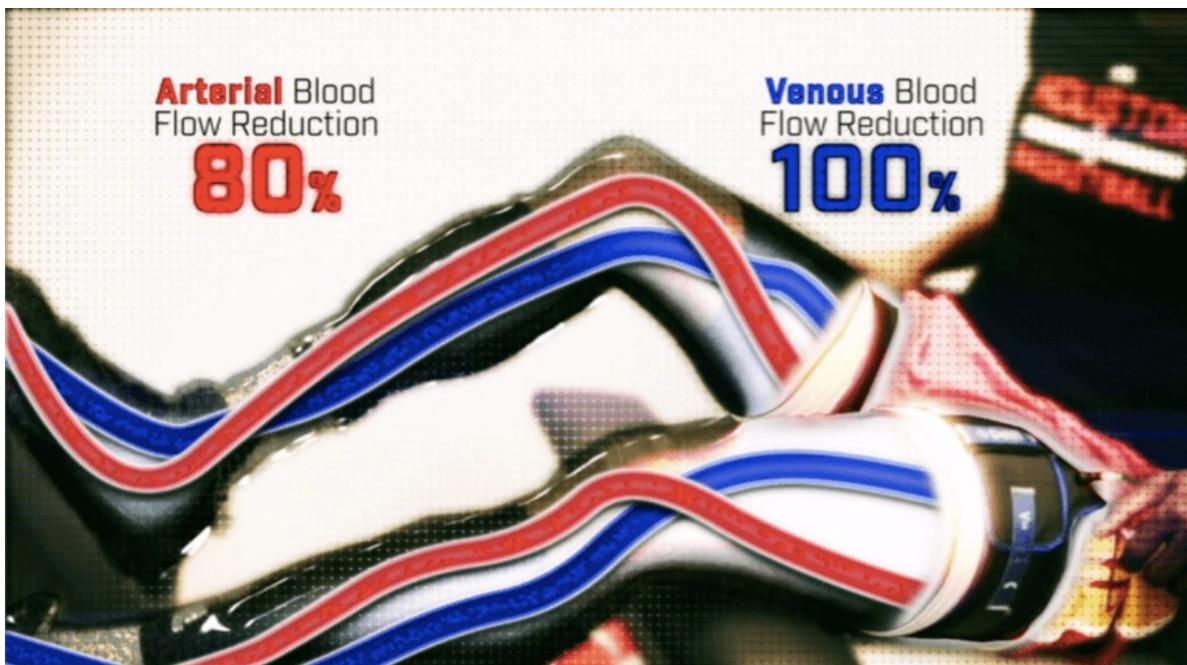
There are only two places that a [blood flow restriction device](#) should be placed: the upper arm and at the upper thigh. Frequently, recommendations of cuff placement at the upper calf or forearms are made. With very superficial nerves in these areas, the amount of compression from a blood flow restriction cuff can cause serious damage resulting in medical conditions such as foot drop. So I'll say it again, **there are only two places that a blood flow restriction device should be placed: the upper arm and at the upper thigh.**



Cuff Pressure

If using a [blood flow restriction training device](#) that allows you to precisely measure the amount of blood flow occlusion (Occlusion Cuff or Delphi unit), we suggest using 50% occlusion for the upper body and 80% for the lower body. This means that all venous blood flow is restricted and only a portion of arterial blood flow comes into the leg.

Due to FDA regulations, medical professionals should only use the Delphi unit as it is the only FDA approved device for BFR.



For those using [compression bands, wraps](#), or other non-objective devices, I suggest using a pressure of 4-5 out of 10 for the upper body

and 6-7 / 10 for the lower body.

Exercise Selection

Almost any exercise used to build strength and hypertrophy can be used with blood flow restriction. From bodyweight to weighted, from open kinetic chain to closed. Power, speed, and jumping exercises should not be used.

Amazingly, several studies have looked at the effects of blood flow restriction training while cycling and walking. With both of these, gains in muscle mass, strength, and VO2 max have been seen. These changes have been as crazy as college basketball players having an 11.6% increase in VO2 max after walking twice a day with BFR for two weeks. No there was not a typo there....2 weeks....11.6% increase! blood flow restriction strength

<https://www.instagram.com/p/BDD64XCBE7S/?taken-by=...>

Sets and Reps

The 30/15/15/15 protocol is what appears the most in the literature and from a clinical and practical application. Here's the breakdown:

30 reps with a 2 second concentric and 2-second eccentric contraction

30 seconds rest

15 reps

30 seconds rest

15 reps

30 seconds rest

15 reps

30 seconds rest

blood flow restriction strength

If the total of 75 reps cannot be completed, repeat the weight next workout (unless less than 50 reps were completed then lower the

weight). If completing the 75 reps isn't SIGNIFICANTLY hard, increase the resistance next time.

Other than that, general rules of weight and / or exercise progression are in play.

BFR training should be performed after other weight lifting exercises.

Here are some more specific examples of how we could use Blood Flow Restriction training for specific athletes.

CrossFit Athlete



CrossFit requires the practice of a wide variety of exercises and skills. To be competitive at the highest level, most athletes have had to take to performing multiple workouts per day. If an athlete knows that a particular body part is weak, it is very difficult to add more training volume to his or her weekly schedule.

For example, an athlete with weak triceps or a weak bench press could add one workout per week of BFR bench press. The light loading doesn't create muscle damage, meaning the athlete's CrossFit workouts will not be hindered by the added training session. blood flow restriction strength

Olympic Weightlifters and Power Lifters

The same applies for Olympic lifters and I've been implementing BFR with my elite lifters for some time now. These elite lifters are already working out 6-10 times per week. Adding heavy resistance training volume isn't an option. BFR is a great option to improve strength & hypertrophy without interfering with their already high training load.

A great program for adding lower body size can see below in Olympic

lifter Lindsey Stroker who is performing BFR split squats to improve lower body strength.

<https://www.instagram.com/p/BJN4cRhhPoa/?taken-by=...>

Bodybuilders

Bodybuilders obviously can about muscle hypertrophy above all else and BFR is an amazing tool for them to add to their arsenal.



Two ways I see this implemented:

First, as a metabolic finisher after a workout of heavy resistance exercises. They might perform close grip bench press, tricep pushdowns, and finish off with BFR dumbbell tricep extensions.

Secondly, blood flow restriction can be a great way to add a second daily workout into their training schedule without impeding recovery.

In Season Athlete



For athletes like basketball or baseball players with multiple games per week, BFR can be used as their strength work when the athlete has a short turn around between games but needs to continue building strength. Then when they have a gap in their schedule, they can do a traditional high intensity workout.

NBA Super Star Dwight Howard was recently featured on ESPN for using BFR as part of his training program in season.

Endurance Athlete

Implement twice weekly blood flow restriction training for maintenance of strength as your endurance training volume increases and reap the potential VO2max benefits. Cycle at 40% of your VO2max for 15 minutes.

<https://www.instagram.com/p/BDD64XCBE7S/?taken-by=...>

Deload Weeks

Need a break from the heavy lifts? BFR on deload weeks is the perfect way to keep strength and hypertrophy going while allowing your body to recover.

Weak Body Parts

While research on traditional resistance exercise suggests 12 weeks of work must be put in before seeing significant improvements, studies on BFR have show significant hypertrophy gains in 2 weeks!

Thus, it's a great tool to rapidly bring up weak body parts.

Recovery & Prehab

As we previously discussed, blood flow restriction training results in a huge release of growth hormone, a key hormone for protecting tendons and muscle structure. BFR can thus be used as a recovery tool or prehab tool. I have some athletes prone to injuries in certain areas regularly perform BFR as a way to augment their body's regeneration to avoid recurring injuries. blood flow restriction strength

Rehab

Finally, BFR has huge implications for rehab. Injured individuals often cannot load a muscle or joint with maximal loads need to build strength and hypertrophy. BFR solves this problem and because of those great [growth hormone responses](#), we've seen rapid changes in many injuries such as tennis elbow, patellar tendonitis, and muscle strains.

From a post-surgical perspective. During periods of non-weight bearing,

BFR has been shown to be highly effective at minimizing the loss of strength and muscle mass. When post-surgical patients can't perform heavy loaded exercises, BFR solves the strength problem...without using any exercises outside the surgeon's protocol. Now those low level "strength" moves you are limited to during early rehab can actually create strength and hypertrophy gains.

NOTE: Tourniquets are FDA regulated medical devices. If using blood flow restriction in the rehab setting please use an FDA approved device such as the one offered at [OwensRecoveryScience.com](https://www.owensrecovery.com). blood flow restriction strength

A great example can be seen in the following video. Jared Fleming, and elite Olympic lifter who holds the American record in the snatch, used blood flow restriction training as part of his ACL reconstruction rehab. While many studies show quad weakness and atrophy long after ACL reconstructions, Jared's surgical leg was 1 inch larger than his non-surgical only three months out!

<https://www.instagram.com/p/BDEIslxBE20/?taken-by=...>

For clinicians wanting to know more about blood flow restriction training, check out courses offered at [OwensRecoveryScience.com](https://www.owensrecovery.com).

The Best Blood Flow Restriction Bands and Devices

The Best Blood Flow Restriction Bands

I am frequently asked about the best devices for performing blood flow restriction training. As with any trend in the fitness world, many manufacturers have come out with products recently. And like most fitness tools, the best device is highly related to your goals.

Unfortunately, some devices on the market have the potential to cause more harm than good, so choosing the appropriate device is needed for both your health and for consistency of performance.

In this, the first of three articles coming out on blood flow restriction training we will cover the first step in BFR...choosing the right device. Choosing the right device based on your goals and safety needs is the first and most important step in implementing BFR into your training or rehab program.

COMPRESSION BAND



First up, and most commonly used are various [compression bands](#) to occlude blood flow. These bands have one really great advantage in that they are very cheap (or even free if you have some lying around). The athlete wraps his or her extremity with a compression band at 4-5/10 intensity for the upper arm or 6-7/10 intensity for the legs is most

commonly prescribed.

The major drawback of these [compression bands](#) is that they cannot be reliably performed in multiple workouts at the exact same level of occlusion. It makes standardizing the level of pressure very difficult. Thus, one workout may be super intense at the prescribed weight and reps while the next may be unbelievably easy.

BLOOD FLOW RESTRICTION BANDS



Up next, you'll find various commercially sold blood flow restriction bands. Again, these are a cheap option but have two big drawbacks. The level of occlusion with these again cannot be reliably reproduced. More importantly, many of these bands are very thin. Thus, **the pressure of the band is put through a much smaller area, risking injury to the underlying nerves.** In fact, on several occasions, these bands have created nerve paralysis. So, if you are buying one of these bands, please choose one that is thick, preferably covering about $\frac{1}{4}$ to $\frac{1}{3}$ of the extremity.

Occlusion Cuff

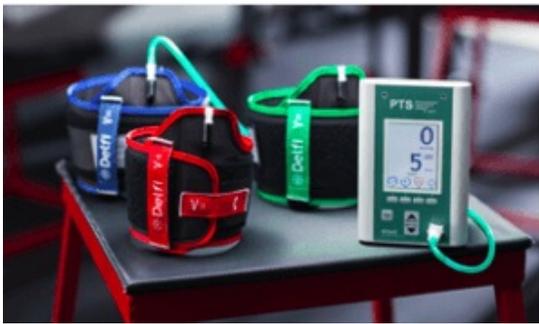


The [Occlusion Cuff](#) has been recently released and does a great job of addressing the above problems. It is essentially a specialized blood pressure cuff designed for blood flow restriction training. At [\\$125](#) it's a great deal given that it is wide enough to not put unnecessary pressure

on the underlying nerves and the sphygmamometer on the Occlusion Cuff allows the individual to precisely measure the level of occlusion. This means workouts will be more standardized to the individual and the exact same amount of pressure can be applied at different workouts. The Occlusion Cuff also comes in a two-pack, allowing you to train both right and left sides at the same time.

For a detailed program on the science and use of BFR check out [Dr. Mario Novo's Blood Flow Restriction Training Manual](#), available in our store.

DELPHI PERSONAL TOURNIQUET SYSTEM



The gold standard blood flow restriction training device is the Delphi Personal Tourniquet System from [OwensRecoveryScience.com](#). This device contains a Doppler ultrasound within the blood flow restriction cuff. This means we have the most accurate way possible to measure blood flow in the extremity and can precisely occlude the appropriate amount of flow. Safety features within the device include rapid shut offs, automatic times, and the Doppler are amazing features.

Most importantly for those in the medical community, the [Delphi Blood Flow Restriction device](#) is the only FDA-approved device for BFR. The [FDA defines full or partial vascular occlusion under "tourniquets"](#) and is regulated that way. Thus, if a patient were to have a negative side effect during BFR training while using a Delphi unit, you can feel legally safe. Using other devices opens you up to litigation because a non-FDA approved device is being used to restrict blood flow.

So, What's The Best?

There are two winners:

First, the [Occlusion Cuff](#) is the clear good for athletes, strength

coaches, and personal trainers. Its ability to measure pressure to accurately reproduce pressure between workouts is great. At a price tag of [\\$125](#), it meets most people's budgets as well.

For the rehab professional, the [Delphi](#) unit wins. This machine is fantastic, with doppler ultrasound and safety features built in. The FDA-approval also makes it a much better option from a legal standpoint. It is the gold standard in BFR due to its safety features, accuracy, and performance.

